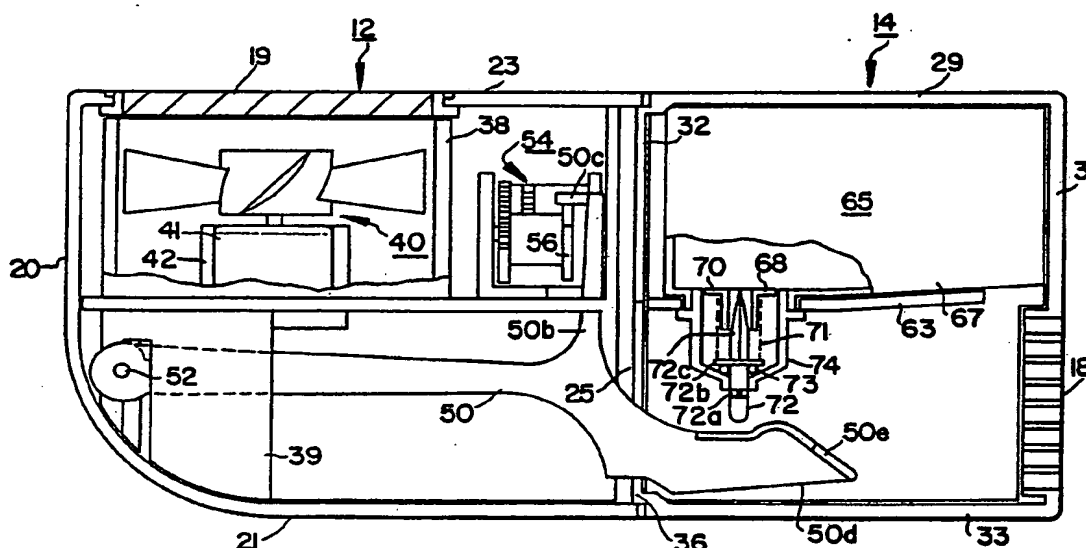




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(54) Title: VAPOR CIRCULATION APPARATUS**(57) Abstract**

A vapor circulation apparatus has a housing with an inlet air opening (18) and an outlet air opening (19) and mounted in the housing is a fan (49) for inducing air flow through the housing and container (65) of liquid to be evaporated. A dosing element (72a) for holding a predetermined volume of the liquid for evaporation is periodically inserted into the container (65) to withdraw a predetermined volume of liquid to be evaporated and after the dosing element (72a) is withdrawn, the container (65) is resealed.

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VAPOR CIRCULATION APPARATUS

TECHNICAL FIELD

5 This invention relates to a vapor circulation apparatus for holding a predetermined volume of liquid material, such as an aromatic oil, for evaporation and for circulating the evaporated matter or fragrance throughout a room. More particularly, this invention relates to a vapor circulation apparatus wherein the liquid
10 to be evaporated is held in a sealed container and wherein the vapor circulation apparatus automatically and periodically unseals the container, withdraws a predetermined volume of the liquid to be evaporated, and then reseals the container.

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BACKGROUND ART

U.S. Patent 3,990,848-Corris discloses a vapor circulation device for distributing a deodorizer or an insecticide in vaporous form. The product to be vaporized is a gel that is packaged in a
20 porous container which is placed in the vapor circulation device. The vapor circulation device also includes a fan which induces air flow past the gel thereby causing sublimed vapors to be circulated out of the housing into the environment.

U.S. Patent 3,804,592-Garbe discloses a vapor circulation
25 device wherein a deodorant is provided in liquid form and is dispersed as a droplet onto a blotter from which the liquid is allowed to evaporate. A fan circulates the evaporated material throughout the environment. Garbe, at column 2, lines 5-10, discloses that by using a variety of inserts with the dispensing
30 opening of the container, one can selectively choose the rate of droplet flow from the container. It is believed that the evaporation time for a given size droplet would be increased if the droplet were not allowed to be dispersed in a blotter. Thus, by eliminating the

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blotter, a given volume of the liquid being vaporized would last longer.

One disadvantage of the gel deodorizer of Corris is that the gel is continuously exposed to the atmosphere. Since the deodorizer is made up of several materials having different evaporation rates and because the fragrance bearing materials generally evaporate faster than the other materials, the perceived fragrance diminishes over time. Even though the liquid drop deodorizer of Garbe employs a wick element to control the drop rate, because the container is not completely sealed, some of the fragrance bearing materials will evaporate from the reservoir supply.

In U.S. Patents 3,617,214-Dolac and 3,739,944-Rogerson, the material that is introduced as a vapor into the environment is packaged in liquid form in a pressurized aerosol container. The spray nozzle of the aerosol container is periodically operated which sprays the product into the environment. One disadvantage of using an aerosol spray is that the atomized liquid particles fall to the floor where they can be stepped on thereby losing their effectiveness as a vapor emitting material.

U.S. Patent 3,085,719-Weber discloses a deodorizer that utilizes a periodically activated drop dispenser. As described at column 5, lines 7-14, the drops are deposited on a heated element where the liquid is heated above its boiling point thereby introducing the vapors into the environment. To maintain the fragrance level in a room, Weber at column 5, lines 32-34 describes drop rates of up to 10 drops per minute.

It is an object of this invention to provide a vapor circulation apparatus, such as an air freshener, wherein the air treatment product is an evaporated liquid.

It is another object of this invention to provide a vapor circulation apparatus wherein a liquid to be evaporated is held in a sealed container and wherein a predetermined volume of the liquid to be evaporated is withdrawn from the container and the container is then resealed.

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And yet another object of this invention is to package a liquid air freshener product in a disposable refill cartridge.

SUMMARY OF THE INVENTION

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In accordance with this invention, there is provided a vapor circulation apparatus having a housing with an inlet air opening and an outlet air opening. A fan in the housing induces air flow through the air inlet opening and expels air from the outlet air opening. A container of liquid to be evaporated is mounted in the housing. The vapor circulation device includes a dosing element for holding a predetermined volume of the liquid for evaporation, means for periodically inserting the dosing element into the container and withdrawing the dosing element with said predetermined volume of liquid, and means for resealing the container after the dosing element is withdrawn.

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In another aspect of the invention, the container comprises a liquid reservoir, a dosing element housing connected to the reservoir for receiving the dosing element, and a membrane seal, located between the reservoir and the dosing element housing, for providing a sealed reservoir.

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In yet another aspect of the invention, dosing element includes a piercing member adjacent the membrane for puncturing the membrane to allow liquid to flow into the dosing element housing.

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It is also contemplated that the liquid container and dosing element are packaged in a disposable refill cartridge and that the refill cartridge has either the air intake or air outlet opening of the completed vapor circulation device. Batteries to power the fan and the means for inserting the dosing pin into the container can also be packaged in the disposable refill cartridge.

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DESCRIPTION OF THE DRAWINGS

While the specification concludes with claims particularly pointing out and distinctly claiming that which is regarded as the present invention, the objects and advantages of this invention can be more readily ascertained from the following description of a preferred embodiment when read in conjunction with the accompanying drawings in which:

Fig. 1 is a perspective view of one embodiment of the vapor circulation apparatus showing a main housing detached from a disposable refill unit;

Fig. 2 is a front cross-sectional view of the vapor circulation apparatus with an attached refill unit in the operating position;

Fig. 3 is an exploded perspective view of the disposable refill unit;

Fig. 4 is a perspective view of the dosing pin for withdrawing a predetermined volume of liquid from the sealed container in the refill unit; and

Fig. 5 is a schematic diagram of the electronic circuits which control the vapor circulation apparatus.

BEST MODE FOR CARRYING OUT THE INVENTION

For the sake of convenience, elements described with reference to a specific figure will retain the same reference designation in the description of subsequent figures. Referring now to Fig. 1, a vapor circulation apparatus 10 is shown, which in one preferred embodiment can be disassembled into a main dispenser unit 12 and a disposable refill unit 14. The housing of the main dispenser unit 12 comprises sidewall 20, bottom wall 21, rear wall 22, top wall 23, and front wall 24. Mounted within the housing of the main dispenser unit is an interior sidewall 25. The housing of the disposable refill unit 14 comprises rear wall 28, top wall 29, front wall 30, sidewall 31, inner sidewall 32 and bottom wall 33.

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Three steps 27 on the bottom wall 21 of the main dispenser unit 12 are spaced from the extended rear wall 22 of the main dispenser unit 12 to form a channel 26 at the lower corner of the extended rear wall 22. Three similar steps 27 extending downward from the top wall 23 of the main dispenser unit 12 form a similar channel 26 at the upper corner of the extended rear wall 22. As best shown in Fig. 3, a rail 34 is formed at the upper rear wall 28 corner and lower rear wall 28 corner (not shown) of the disposable refill unit 14. The end of each rail 34 can be pointed and gradually increase to have a thickness greater than the rail 34 but less than the width of channel 26 to form a latch 35 at the end thereof. To assemble the disposable refill unit 14 to the main dispenser unit 12, upper and lower rails 34 are inserted into channels 26 and as the rails 34 slide in their respective grooves 26, the alignment of the disposable refill unit 14 is maintained as it is assembled with the main dispenser unit 12. When refill unit 14 is assembled into the main dispenser 12, ramp 47, shown in Fig. 1, exerts a force to the back of spring finger 28a on rear wall 28 of the refill unit 14 which locates latch 35 beyond the width of channel 26 and the application of a lateral force only to disassemble refill unit 14 will cause latches 35 to engage the innermost steps 27 of the main dispenser unit 12. To disassemble the refill unit 14 from the main dispenser unit 12, pressure is applied to front wall 30 of refill unit 14 which locates latch 35 entirely within channel 26 while applying a lateral force to refill unit 14 thereby causing rails 34 to slide in channels 26 to remove the refill unit 14. If desired the assembled vapor circulation apparatus 10 can be mounted to a wall or other surface using well known means such as double sided adhesive or screws.

Referring now to Fig. 2 which shows the disposable refill unit 14 assembled with the main dispenser unit 12, the composite vapor circulation apparatus housing has an air intake opening 18 at the lower corner of the disposable refill unit 14 and an air outlet opening 19 located in the top wall 23 of the main dispenser unit 12.

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The air outlet opening 19 is in the form of a louvered disk which is rotatably mounted in the top wall 23 so that the direction of air flow from the vapor circulation apparatus 10 can be controlled. If it is necessary for the vapor circulation apparatus 10 to have interior vertical walls such as interior sidewall 25 of the main dispenser unit 12 and interior sidewall 32 of the disposable refill unit 14, the interior sidewall 25 is constructed to have an opening 44 (best shown in Fig. 1) which corresponds with an opening 45 (best shown in Fig. 3) in interior sidewall 32 of the disposable refill unit 14 in order to provide an air flow path between the air intake opening 18 and air outlet opening 19.

As shown in Fig. 2, the main dispenser unit 12 also includes a fan 40 for pulling air into the air intake opening 18 and expelling air out of air outlet opening 19; an actuator 50 that is pivotally mounted at one end about pivot 52 for causing a drop of liquid to be withdrawn from a container 65 in the disposable refill unit 14; means 54 for periodically operating the actuator 50; and electronics on a printed circuit board 80, shown schematically in Fig. 5, for controlling the operation of the fan 40 and the means 54 for operating the actuator 50. The fan 40 is mounted within a fan shroud 38 and the fan motor 41 is mounted in motor housing 42. The pivotally mounted actuator 50 includes a vertical leg member 50b which terminates in a shoulder 50c. The means 54 for periodically operating the actuator 50 includes an actuator motor 55 (shown schematically in Fig. 5) which drives a gear train and attached cam 56 which contacts the lower surface of shoulder 50c to impart vertical motion to the shoulder 50c. Cam 56 makes one revolution for 87.5 revolutions of the shaft output of actuator motor 55.

The refill unit includes a container 65 of liquid to be evaporated and batteries 78 (best shown in Fig. 3) for driving the electronics on printed circuit board 80, the fan 40 and the means 54 for operating actuator 50.

Referring now to Fig. 3, the rear wall 28 of the disposable refill unit 14 includes upper extension 60a which fits under the top

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5 wall 29 and lower extension 60b which fits over the bottom wall 33 of the refill housing. The disposable refill unit 14 also has a vertical support wall 62 for supporting two batteries 78 which are connected in series by means of shorting bar 79. Also mounted to the vertical support wall 62 is a shelf 63 for holding the container 65 of liquid to be evaporated. Referring now to Figs. 2 and 3, the sealed container 65 comprises a liquid reservoir 67, the top of which is sealed with a metal foil 66. Also forming a part of the liquid container 65 is a dosing valve housing 74 which contains therein an O-ring seal 73, a dosing pin 72, a compression spring 71 and an upper spring retaining disk 70. As best shown in Fig. 4, the lower portion of dosing pin 72 has a diameter of 0.381 centimeters (0.150 inches) and has four wedges each capable of holding about 0.016 cubic centimeters (0.001 cubic inches) of liquid to be evaporated. The central portion of dosing pin 72 is disc-shaped to provide a lower support 72b for compression spring 71. The upper portion of dosing pin 72 forms a piercing member 72c. Referring again to Figs. 2 and 3, the upper compression disk 70 is pressed into the dosing valve housing 74 over a plurality of bosses (not shown) near the upper edge of the dosing pin housing 74 and the upper opening of dosing pin housing 74 is sealed with foil membrane 68. The upper spring retaining disk 70 has an elongated axial opening which fits over the piercing member 72c to guide the piercing of metal foil seal 68. The sealed dosing pin housing assembly is then press fit into an opening in the lower wall of the liquid reservoir 67 to provide a completely sealed liquid container. When the refill support wall 62 with the liquid container 65 and battery 78 mounted thereon is assembled into the refill unit 14, the battery electrodes will line up with holes 37a and 37b in inner sidewall 32 of the refill unit 14 and dosing pin 72 will be located in the air flow path between air intake opening 18 and opening 45 in interior sidewall 32.

Referring now to Fig. 5, the control electronics for the fan 40 and the actuator 50 are contained on printed circuit board 80

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mounted within the main dispenser unit 12. The control is provided by a four-bit microprocessor integrated circuit 81 that has been specially designed by means of the masks used to fabricate the integrated circuit 81 to provide the desired control outputs.

5 Control output 81a of the microprocessor 81 is applied to an amplifier 82 which drives the coil 43 of fan motor 41. Control output 81a is a repetitive signal that turns the fan on for 75 seconds and turns the fan off for 75 seconds. Control output 81b of microprocessor 81 is applied to amplifier 83 which drives the coil

10 55a of actuator motor 55. Control signal 81b is a signal that operates the actuator motor coil 55a for a half second every 20 minutes with the additional requirement that when battery 78 is initially connected to the printed circuit board 80, the actuator motor 55 is operated for 0.5 seconds every 1.5 seconds for 8

15 cycles. Since the liquid container 65 holds a two-month supply of liquid to be evaporated, microprocessor 81 is designed to operate the fan motor 41 and the actuator motor 55 for about 56 days after which the fan motor 41 and the actuator motor 55 are disabled.

The actuator drive means 54 has a second shaft output 54b

20 which drives cam 57 and controls the opening and closing of switch 58. The function of cam 57 and switch 58 is to make sure that the actuator drives mean 54 stops at approximately the same point in a cycle. The actuator motor control signal from amplifier 83 operates actuator motor 55 for a time that is less than the time that it takes

25 for the actuator drive 54 to complete one full dosing cycle which can vary from about 0.75 to 1.0 seconds depending on the battery 78 voltage. The shape of cam 57 is such that shortly after the actuator motor 55 is energized, cam 57 will close switch contacts 58a and 58b thereby connecting ground to the end of the actuator motor

30 55a that is actually driven by amplifier 83 so that when amplifier 83 turns off before the completion of a dosing cycle, the ground connection through switch 58 keeps the coil 55a of actuator motor 55 energized. The actuator motor 55 will continue to operate until the shape of cam 57 allows switch contacts 58a and 58b to open thereby

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removing power from the actuator motor 55. Thus, the beginning and end of a dosing cycle is really controlled by the shape of cam 57 and not by the length of time that amplifier 83 is turned on.

Control output 81c of microprocessor 81 is applied to amplifier 84 which drives piezo alarm element 85. The piezo alarm element 85 is driven by a 4096 cycle square wave burst lasting 0.0625 seconds. When a refill cartridge 14 is initially assembled with the main dispenser unit 12, eight such 4096 cycle square wave bursts are spaced equally over one second, then the piezo alarm element 85 is turned off for three seconds, and then another eight bursts are generated. After the microprocessor 81 has timed the 56 days of operation and has disabled the fan motor 41 and the actuator motor 55, the piezo alarm element 85 is then activated from time to time over a four-day period to signal that the disposable refill unit should be replaced. At the end of those four days, the microprocessor 81 will not again activate the piezo alarm element 85 unless the disposable refill unit 14 is replaced.

What now follows is a brief description of the use and operation of the vapor circulation apparatus 10 through a complete life cycle of a disposable refill unit 14. To assemble the refill unit 14 with the main dispenser unit 12, rails 34 of the refill unit housing are placed into the channels 26 formed at the extended portion of rear wall 22 of the main dispenser unit 12. Referring to Fig. 2, as the refill unit 14 is pushed into assembly with the main dispenser unit 12, the sloped surface 50e of actuator 50 contacts the bottom of dosing pin 72. As the refill unit 14 is further pushed into assembly with the main dispenser unit 12, the combination of the sloped surface 50e of actuator 50 and the action of step 36 formed in inner sidewall 32 of the refill unit 14 on the lower inclined surface 50d of actuator 50 exerts an upward force on the dosing pin 72 allowing the upper piercing member 72c of the dosing pin 72 to break foil membrane 68 which will allow liquid in the reservoir 67 portion of container 65 to flow into dosing pin housing 74. When the assembly of the refill unit 14 with the main dispenser unit 12 is

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completed, electrical contacts 46a and 46b (shown in Fig. 1) will extend through holes 25a and 25b in sidewall 25 of main unit 12 and through corresponding holes 37a and 37b in the inner sidewall 32 of the refill unit 14, as shown in Fig. 3, and make contact with the electrodes of battery 78 thereby providing power to printed circuit board 80 which initiates a 60-day timing cycle for controlling the fan motor 41, the actuator motor 55 and the piezo alarm element 85. Approximately two seconds after the microprocessor 81 has been first activated, the piezo alarm element 85 is operated for eight seconds as previously described so that the person assembling the refill unit 14 to the main dispenser unit 12 can be provided with some indication that the printed circuit board 80 is functioning properly. Also, two seconds after the microprocessor 81 has been energized, the actuator motor 55 is energized eight times during the next eleven seconds thereby causing dosing pin 72 and its piercing member 72c to be respectively inserted into the dosing pin housing 74 and fluid reservoir 67 and then withdrawn eight times which primes the dosing valve housing 74 so that it becomes filled with the liquid to be evaporated. After the eighth of these priming cycles, the four wedges 72a of dosing pin 72 will each contain about 0.016 cubic centimeters (0.001 cubic inch) of liquid for evaporation and subsequent circulation by the vapor distribution apparatus 10. Due to the action of compression spring 71 which returns dosing pin 72 to the withdrawn position and maintains pressure on O-ring seal 73, the container 65 is effectively resealed after the dosing pin 72 has been withdrawn from the dosing pin housing 74. Because of this resealing, the various components of the liquid cannot evaporate from the container 65 and the effectiveness of the liquid is maintained over the two-month expected life of the refill unit 14. Seventy-seven seconds after the refill unit 14 is assembled to the main dispenser unit 12, the microprocessor 81 turns on the fan for 75 seconds and continues the 75 second on, 75 second off periodic operation of the fan 40 for 56 days. Twenty minutes after the refill unit 14 is assembled to the main dispenser unit 12, the

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microprocessor 81 will insert dosing pin 72 into dosing pin housing 74, withdraw another sample of liquid to be evaporated, and reseal the container 65. This sampling rate has been determined by the evaporation rate of the liquid which is such that about 90% of the sample evaporates in 20 minutes. This 20-minute sampling period will continue for 56 days. At the end of the 56-day period the actuator motor 55 and the fan motor 41 will be disabled, that is, they will not be energized any longer. The microprocessor 81 will then periodically activate the piezo alarm element 85 as a signal that the refill unit 14 needs replacement. At the end of the 60th day from the assembly of the refill unit 14 with the main dispenser unit 12, the microprocessor 81 will also disable the piezo alarm element 85.

While the present invention has been described with respect to a specific embodiment thereof, it will be obvious that various changes and modifications may be made without departing from the invention in its broader aspects. For example, both the air intake opening and the air outlet opening can be formed in the housing of the main dispenser unit. It is contemplated in the appended claims to cover all variations and modifications of the invention which come within the true spirit and scope of my invention.

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What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A vapor circulation apparatus comprising:
 - (a) a housing having an inlet air opening and an outlet air opening;
 - (b) means in the housing for inducing air flow through the housing;
 - (c) a container of liquid mounted in the housing;
 - (d) a dosing element for holding a predetermined volume of the liquid for evaporation;
 - (e) means for periodically inserting the dosing element into the container and withdrawing the dosing element with said predetermined volume of liquid; and
 - (f) means for resealing the container after the dosing element is withdrawn.
2. A vapor circulation apparatus as recited in claim 1 wherein the means for inducing air flow is a periodically activated fan.
3. A vapor circulation apparatus as recited in claim 1 wherein the container comprises:
 - (a) a liquid reservoir;
 - (b) a dosing element housing connected to the reservoir; and
 - (c) a membrane seal, located between the reservoir and the dosing element housing, for providing a sealed reservoir, and wherein the dosing element is capable of being inserted into the dosing element housing.
4. A vapor circulation apparatus as recited in claim 3 wherein the dosing element includes a piercing member adjacent the membrane for puncturing the membrane to allow liquid to flow into the dosing element housing.
5. A vapor circulation apparatus as recited in claim 1 wherein the liquid container and dosing element are packaged in a disposable refill cartridge.

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6. A vapor circulation apparatus as recited in claim 5 wherein the disposable refill cartridge is attached to the vapor circulation apparatus housing and contains one of the air openings.
7. A vapor circulation apparatus as recited in claim 5 wherein the container comprises:
 - (a) a liquid reservoir;
 - (b) a dosing element housing connected to the reservoir; and
 - 5 (c) a membrane seal, located between the reservoir and the dosing element housing, for providing a sealed reservoir, and wherein the dosing element is capable of being inserted into the dosing element housing.
8. A vapor circulation apparatus as recited in claim 7 wherein the dosing element includes a piercing member adjacent the membrane for puncturing the membrane to allow liquid to flow into the dosing element housing.
9. A disposable cartridge of liquid to be attached to a vapor circulation apparatus having a housing with an inlet air opening and an outlet air opening, means in the housing for inducing air flow through the housing, and a periodically operated actuator, said
5 disposable cartridge comprising:
 - (a) a container of liquid;
 - (b) a dosing element for holding a predetermined volume of the liquid for evaporation, said dosing element being responsive to the actuator so as to be periodically inserted into the container;
 - 10 (c) means for withdrawing the dosing element from the container with the predetermined volume of liquid; and
 - (d) means for resealing the container after the dosing element is withdrawn.
10. A disposable cartridge as recited in claim 9 for use with a vapor circulation apparatus having a housing that has one of the air openings, the other air opening being in the disposable cartridge.
11. A disposable cartridge as recited in claim 9 wherein the container further comprises:

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- 5 (a) a liquid reservoir;
- (b) a dosing element housing connected to the reservoir; and
- 5 (c) a membrane seal, located between the reservoir and the dosing element housing, for providing a sealed reservoir, and wherein the dosing element is capable of being inserted into the dosing element housing.
12. A disposable cartridge as recited in claim 11 wherein the dosing element includes a piercing element adjacent the membrane for puncturing the membrane to allow liquid to flow into the dosing element housing.
13. A disposable cartridge as recited in claim 12 further comprising means for aligning the cartridge as it is attached to the vapor circulation apparatus housing and a surface for moving the actuator so that the piercing member connected to the dosing
- 5 element ruptures the membrane.

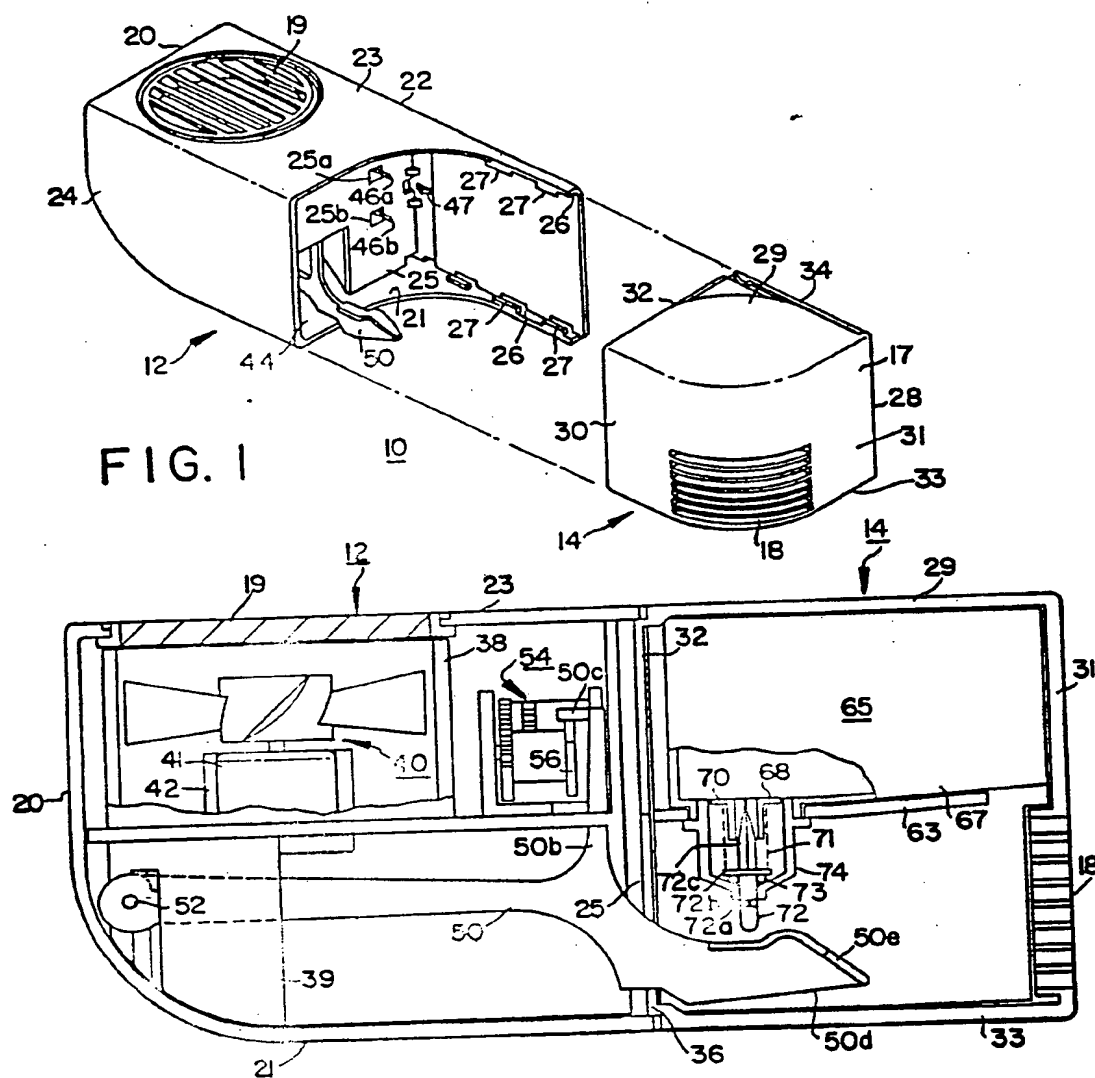


FIG. 2

SUBSTITUTE SHEET

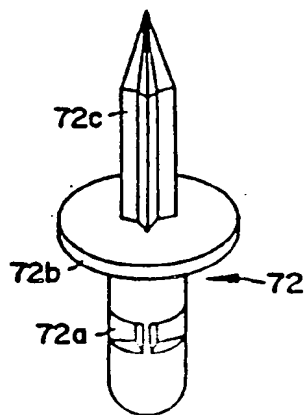


FIG. 4

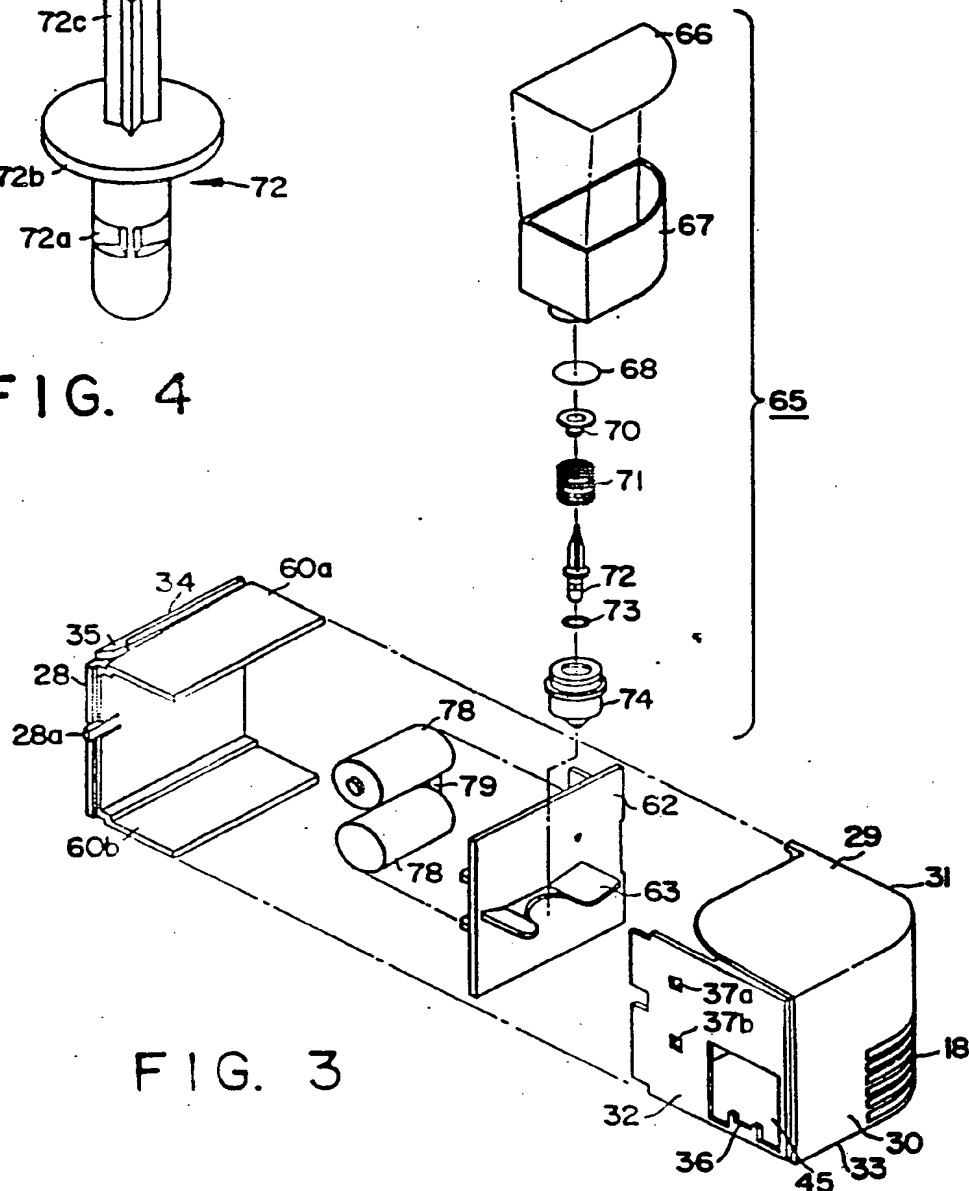


FIG. 3

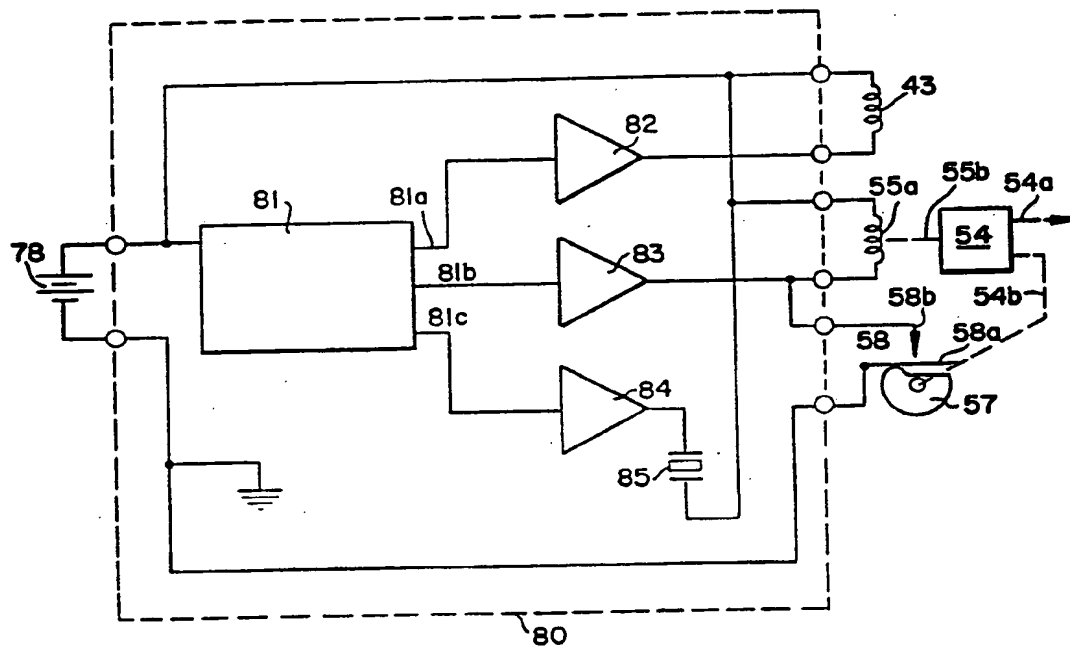


FIG. 5

SUBSTITUTE SHEET

INTERNATIONAL SEARCH REPORT

International Application No PCT/US88/01570

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) ³		
According to International Patent Classification (IPC) or to both National Classification and IPC		
IPC (4) A61L 9/03, 9/04		
U.S. Cl. 422/124		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁴		
Classification System ¹	Classification Symbols	
U.S.	422/124, 116; 222/83,83.5 239/272,37,38,57: 261/62, Dig. 17	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁴		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴		
Category ⁵	Citation of Document, ¹⁶ with Indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. ¹⁸
Y	US, A, 4,166,087 (CLINE ET AL) 28 August 1979. See entire document.	1,2
Y	US, A, 4,601,886 (HUDGINS) 22 July 1986. See entire document.	1,5
Y	US, A, 2,867,866 (STEELE) 13 January 1959. See entire document.	1,2
Y	US, A, 2,241,097 (MEZZAPESA) 6 May 1941. See column 1, lines 9-17.	3,4,7,8
Y	US, A, 4,574,985 (SYKES) 11 March 1986. See entire document.	3,4,7,8
<p>¹⁵ Special categories of cited documents: ¹⁹</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"A" document member of the same patent family</p>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search ⁴	Date of Mailing of this International Search Report ⁴	
08 July 1988	18 AUG 1988	
International Searching Authority	Signature of Authorized Officer ²⁰	
ISA/US	AMALIA L. SANTIAGO	

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

Y	US, A, 3,990,848 (CORRIS) 9 November 1976. See entire document.	1,6
Y	US, A, 3,085,719 (WEBER III) 16 April 1963. See entire document.	1,2

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE ¹⁰

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers because they relate to subject matter ¹² not required to be searched by this Authority, namely:

2. ☐ Claim numbers because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent ¹³ that no meaningful international search can be carried out ¹³, specifically:

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING ¹⁴

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.
2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:
3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:
4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

- ☐ The additional search fees were accompanied by applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.